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(54) Connector for the pneumatical and electrical coupling between a gases supply means and a gas conduit

(57) The present invention relates to the connections between respiratory humidifiers and/or other such devices and heated breathing conduits used to couple a patient to the humidifier. In particular, the invention is a connector to couple a gases supply means and a conduit, such that the connector causes there to be an electrical and pneumatic, that is, scaled connection between a conduit including an electrical wire extending within,

throughout or about it and a gases supply device, such as a humidifier, blower or the like. The connector may be of a single port type or a dual port type. The dual port type connector is suitable for ventilator apparatus that have a dry line (dry breathing conduit) extending from a ventilator or blower that carries dry gas to a humidifier and an inspiratory limb that extends from the humidifier to the patient and carries humidified gases to the patient.

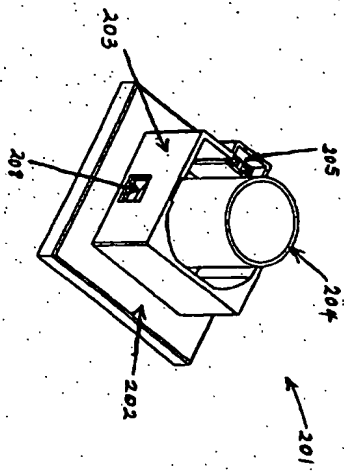


Figure 8

Description
FIELD OF INVENTION

[0001] The present invention relates particularly, though not solely, to the delivery of humidified pressurised oxygen and/or air to a patient. In particular, the present invention relates to the connections between respiratory humidifiers and other such devices and heated breathing conduits used to couple a patient to the humidifier.

SUMMARY OF THE PRIOR ART

[0002] In order to supply gases to a patient or a person needing such gases, it may sometimes be necessary to first humidify those gases, for example using a respiratory humidifier/ventilator system. In such a case where the gases have been humidified, and therefore laden with water, it is likely that during transport through a conduit to the patient, condensation of that water vapour will occur. In order to overcome this disadvantage it is known to associate a heater wire with respiratory humidifier breathing conduits to avoid condensation. Examples of such a heated breathing conduit are disclosed in US 5,537,996 (McPhae) and US 5,392,770 (Crawson et al.). A connector that simply fits into the humidifier chamber outlet is currently known that provides for connection between a humidifier and a breathing conduit. To provide Figure 1 illustrates how current is supplied to the heater wire within the breathing conduit and the connection between the conduit and humidifier. The humidifier 102 has a humidification chamber 103 having an inlet 104 that is connected to the outlet of a device that supplies gases to the humidifier. The humidification chamber 103 also has an outlet 105. A connector 106 causes the connection between the breathing conduit 101 and the outlet 105. The connector 106 is located at one end of the conduit 101. The end of the connector 106 fits snugly into or about the outlet 105. The wire within the breathing conduit 108 is heated by way of the external connector 109 that is connected via known electrical wiring to the humidifier base 110.

[0003] Existing connectors of this type have the disadvantage that there are external wires that may cause problems for the user and will be in the way when in use. Furthermore, the connection between the breathing conduit and the humidifier outlet does not provide an optimal connection.

SUMMARY OF THE INVENTION

[0004] It is an object of the present invention to provide a connector between a gases supply means and a heated breathing conduit that goes some way towards overcoming the abovementioned disadvantages.

[0005] In a first aspect the present invention consists in a connector to couple a gases supply means and a

conduit, where said conduit includes electrical wire extending within, throughout or about said conduit, said connector comprising:

a male portion of a generally tubular shape connected to one of said gases supply means and said conduit, said male portion having a locking connector receiving means and an electrical connector receiving means;
a female portion of a generally tubular shape connected to one of said gases supply means and said conduit, said female portion having a locking connector means and an electrical connector means.

wherein coupling of said male and female portions causes said locking connector means to engage with said locking connector receiving means and lock said male and female portions together, and said coupling simultaneously causing said electrical connector means to engage with said electrical connector receiving means making a pneumatic seal and electrical connection between said male and female portions and consequently between said gases supply means and said conduit.

[0008] To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] One preferred form of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a connector used in prior art devices to provide the connection between a breathing conduit and humidifier.

Figure 2 is a schematic diagram of a respiratory humidification system that may incorporate the detection of conduit overheating system of the present invention.

Figure 3 is an illustration of a respiratory humidifier system that utilises the connector of the present invention.

Figure 4 is an illustration of the humidifier base of the respiratory humidifier system of Figure 2, and Figure 5 is a perspective view of apparatus that is used in conjunction with the connector of the present invention, wherein the gases supply means and humidifier are contained within an enclosure.

Figure 6 is a front view of the apparatus of Figure 5, Figure 7 is a side view of the heated gas delivery system as connected to the connector of the present invention.

latched, in an appropriate manner, to the chamber of the humidifying apparatus. In some forms of this connector the base 202 will be the body of the humidifying chamber itself, but in other forms the base may be clipped, welded, moulded or otherwise appropriately attached to the chamber or base of the humidifier. The male portion itself is separately injection moulded, but in the male portion may be moulded integrally with the humidifier chamber. For example, in some cases the mechanism that provides the pneumatic sealing between the humidifier and the conduit could be separately attached to the chamber of the humidifier, but be freely removable and be sealed by way of an O-ring or other appropriate means to the humidifier.

[0020] Extending from the base 202 of the male portion is the body 203 and further extending from the base 202 and within the body 203 is a tubular protrusion 204. As can be seen in Figure 10 the tubular protrusion 204 extends through the body section 202 and about the circular recess 205 located in the base of the male portion, in order to allow gases to flow through the male portion from the chamber.

[0021] Located on the body 203 of the male portion is an electrical socket 205 having conductors 206, 207. On the wall of the body, there are two elongate apertures 208, 209 that serve to receive complementary protrusions on the female portion, so that when the male and female portions are coupled the protrusions reside within the apertures on the male portion causing a pneumatic connection.

[0022] In use, gases flow from the humidifying chamber through the recess 205 into the tubular protrusion 204 then into the female portion of the connector attached to the breathing conduit, and finally through into the breathing conduit to the patient.

[0023] The female portion of the connector will now be described with reference to Figures 11 to 13. The female portion 210 is a generally tubular member that is attached about, or within the breathing conduit (not shown) in an appropriate manner. The female portion 210 is manufactured by injection moulding from a plastics material but other appropriate methods of manufacture or materials may be used. The female portion 210 comprises a sleeve 211 having an electrical port 212 and protrusions 213 located on either side of the outer wall. Extending within the sleeve 211 is a port 214 that is also tubular in shape. The electrical port has pins or contact surfaces located within it (not shown) that are connected to the heater wire (as already described) residing within or about the breathing conduit. Soldering or fastening the heater wire to the pins or contact surfaces by appropriate fastening means causes connection from the electrical port 212 to the heater wire. The pins or contact surfaces can be either moulded into the port 212 during the moulding of the female portion, or may be inserted into the port 212 after moulding.

[0024] When the male portion 201 and female portion 210 are coupled the tubular protrusion 204 slides be-

tween the tubular port 214 and the sleeve 211. Simultaneously the protrusions 213, 215 fit into the apertures 208, 209 and the electrical port 212 fits into the socket 205. Thus the meeting of the male and female portion achieves a simultaneous electrical and pneumatic connection to be made.

[0025] The protrusions 213, 215 and apertures 208, 209 also have the effect of providing a quick release mechanism that allows user-friendly and efficient release of the circuit from the humidifier. When a user wishes to remove the male portion from the female portion they need only push the protrusions 213, 215 inward releasing them from the apertures 208, 209 and remove the male portion from within the female portion.

[0026] In further forms of the connector as described above, a taper may be provided on the inner walls of the female or male portions and a gasket placed in between the two surfaces. Alternatively, a thread or a bayonet type fitting could be used to create the pneumatic seal instead of the taper and/or quick release mechanism described above.

[0027] The conductors referred to above may be assembled with the male portion then over-moulded, or may be inserted into the electrical connector on the male portion after the portion has been moulded. Alternatively, a separate sub assembly with the conductors could be formed and threaded onto the conduit, and then over-moulded.

[0028] In preferred forms of the present invention, a small indicator, such as an LED, is embedded in either the male or female portion of the connector to allow for visual confirmation of an active circuit, so as to indicate both an electrical connection and a pneumatic seal.

[0029] The heater wire located within the breathing conduit could also be accompanied by at least one additional electrical lead that can also carry signals from measuring sensors placed at the end or at intermediate positions along the conduit. Furthermore, the heater wire itself could be used to carry electrical signals from measuring sensors. When additional leads are supplied additional pins and/or contacts are supplied within the electrical part of the connector.

[0030] A second form of a "single port" connector according to the present invention is shown in Figures 18 to 26. This connector is comprised of a generally tubular shaped male portion 400 and similarly shaped female portion 401, where the male portion is flange within the female portion. Referring to Figures 18, 19, 22 and 23 it can be seen that the female portion 401 has a tubular pathway 402 through it, to allow gases to pass through the portion 401 into the conduit 403. The female portion 401 is a thermoplastic insert that has a body section 405 and a threaded end 404 that is of a reduced diameter compared to the body section 405. The body section 405 has a protrusion 406 that defines an electrical port or recess when the female portion is moulded to the conduit 403. The electrical port 406 is of generally rectangular shape and extends from the outer surface of the

body section 405.

[0031] The insert 401 is attached to the conduit 403 by threading the conduit about the end 404. The conduit and insert 401 are then over moulded, where a number of recesses 422 located on the outer surface edge of the insert 401 nearest the threaded end 404 allow the plastics material used for moulding (such as a thermoplastic elastomer) to flow into the insert, forming a gasket. After moulding the plastics material from the moulding forms an outer surface covering 405 of thermoplastic elastomer over the conduit and insert.

[0032] Additionally, at least one pivoting member 408 is integrally formed in the polycarbonate body section 405 of the insert 401. The pivoting member is a portion of the standard tubular shape of the body section that is defined by channels 409 cut from the body section to leave a bridging member. In cross-section as shown in Figure 23, the body section has two pivoting members 408, 410, where the thickness of the upper arms 411, 412 of the pivoting members increases nearer the top of the arms 411, 412, forming an outwardly extending protrusion from the surface of the body section 405. The lower arms 413, 414 have small inwardly extending protrusions 415, 416 that engage with the male portion of the connector 400, forming a pneumatic connection between the male and female portions of the connector when these are coupled. As can be seen in Figures 18, 21, 22 and 23 once the insert 401 and conduit 403 are over moulded, the protrusions 417, 418 are formed in the outer covering 407 by the top edges of the upper arms 411, 412. The pivoting member 408 acts such that when the protrusions 417, 418 are pushed inward the upper arms 411, 412 are moved inward causing the lower arms 413, 414 and small protrusions 415, 416 to pivot outward.

[0033] Referring to Figure 22, before the over moulding of the insert and conduit, pins 420 are inserted into the recess 419 in the electrical port 406. Each of the pins is connected by appropriate means to the wires within the conduit. For example, each pin can be soldered to a connecting wire 421 and then the other end of this wire is soldered to the wires extending about or within the conduit. Again, this type of connection allows for power to be supplied to the conduit without externally running wires.

[0034] Reference is now made to Figures 20, 24, 25 and 26, which illustrate various views of the male portion 400 that couples with the female portion 401 of the alternative form of a single port connector of the present invention. The male portion 400 is generally tubular in shape, to allow gases to flow through the portion, but the diameter of the portion 400 decreases slightly, near the connection end 423, forming a tapering end on the portion 400. Pathway along the portion 400 is a groove 425, spanning the circumference of the portion 400, in which the small protrusions 415, 416 on the female portion 401 fit or clip into when the connection end 423 of the male portion 400 is coupled to the female portion.

[0035] Located below the groove 425 is a rim 427, which prevents the male portion 400 from being pushed too far into the female portion 401. Located on one part of the oval shaped rim 427 is a rectangular shaped protrusion 426, forming an electrical connector, which houses elongate recesses that receive the pins 420, when the male and female portions are coupled. At the base of the elongate recesses is an electrical contact that is connected to standard wiring 428 to the power supply, usually retained within the humidifier control mechanisms.

[0036] In use, once the male portion 400 is attached to the humidifier and the female portion 401 moulded to the conduit 403, a connection is formed between the conduit 403 and the humidifier by coupling the male and female portions together. Once coupled a pneumatic connection is made as the tubular body of the male portion fits within the tubular portion of the female body and the small protrusions 415, 416 clip into the groove 425, preventing removal of the male portion from the female portion. Simultaneously, the projection 426 on the male portion extends into the recess 419 in the electrical connector 406 on the female portion 401 and the pins 420 extend into the elongate recesses in the projection 426, thus an electrical connection is formed between the conduit wiring and the humidifier.

[0037] To remove the male portion from the female portion a user is simply required to apply pressure to the protrusions 417, 418 formed in the outer covering 407 of the female portion thereby releasing the small protrusions 415, 416 from the groove 425 on the male portion. The male portion can then simply be removed from within the female portion, thereby disconnecting the electrical connection between the two portions.

[0038] The male portion 400 is separately attached by appropriate means to the outlet of a humidifier chamber at the inlet end 424 of the male portion 400. Although in other forms the male portion 400 may be formed integrally with the chamber of the humidifier, forming the outlet port of the chamber.

[0039] A third form of a "single port" connector according to the present invention as shown in Figures 28 to 36 a connector in this form is comprised of three parts, a sliding collar 600, a female portion 601 and a male portion 602, where the male portion is flange within the female portion and the sliding collar slides over and about the female portion 601. The three parts, the sliding collar 600, the female portion 601 and the male portion 602, are generally tubular in shape to allow gases to pass through the tubular pathway formed between the male and female portions. Each of these portions is injection moulded in a plastics material, but other appropriate methods of manufacturing may be used. The sliding collar is preferably moulded from acetyl, and the male and female portions from polypropylene, but other appropriate materials such as other thermoplastic materials may be used.

[0040] The sliding collar as depicted in Figures 29 and

the locking of the male and female portions together. The latch may be formed integrally with the female portion, residing approximately where the electrical protrusion 309 is located. Similarly, the recess may be integrally formed with the electrical recess 306 of the male portion. Alternatively both the latch and recess may be formed in the male and female portions at other appropriate locations. On insertion, a simultaneous electrical connection is made as the rectangular shaped electrical protrusion 309 located on the female portion 305 is inserted into the electrical recess 306 of the male portion 300. The electrical protrusion 309 is connected to wiring within the humidifier and subsequently to the control mechanisms within the humidifier, to provide power to the electrical wiring and to control the heating of the conduit, or to pick up signals sent through the wiring, similar to that as described above.

[0052] The female portion 305 may form part of the chamber of the humidifier or may be attached by appropriate means to the humidifier, similar to that of the single port form of the connector as described above in relation to Figures 8 to 13.

[0053] The male 300 and female 305 portions are ion 305 may be integrally injection moulded with the humidifier chamber. Each of these portions may be formed by other appropriate methods.

[0054] A dual port connector of this type allows for the connector to be easily dismantled and cleaned. Furthermore, the connector part, being made from a plastic type material is inexpensive to manufacture and will give hospitals and patients the option to dispose of the connector rather than to clean and disinfect the connector for reuse.

Claims

1. A connector to couple a gases supply means and a conduit, where said conduit includes electrical wire extending within, throughout or about said conduit, said connector comprising:
a male portion of a generally tubular shape connected to one of said gases supply means and said conduit, said male portion having a locking connector receiving means and an electrical connector receiving means,
a female portion of a generally tubular shape connected to one of said gases supply means and said conduit, said female portion having a locking connector means and an electrical connector means,

wherein coupling of said male and female portions causes said locking connector means to engage with said locking connector receiving means and lock said male and female portions together,

male portion and chamber. Furthermore, the o-ring 624 meets with the inner surface of the upper section 609 of the female portion creating a seal between the male and female portions.

Cartridge Type Humidifier and Connector

[0048] In other forms of the present invention, such as that shown in Figure 77, the electrical connector part 500 of a male connector, similar to that described above, is located on the base 503 of a humidifier 504. The humidifier 504 has a cartridge type chamber 502 that has the pneumatic connector part 501 of the male connector located on it. As shown in Figure 28 when the female portion of the connector 505 (attached to the end of a breathing conduit 506) is connected to the male portions (both the pneumatic 501 and electrical 500 parts) the female portion 505 fits over both the pneumatic part 501 and electrical part 500 causing both a pneumatic and electrical connection to be made between the breathing conduit 506 and humidifier 504.

Dual Port Electrical/Pneumatic Connector

[0049] During use of ventilator apparatus in a hospital, where there is a humidifier and at least one breathing conduit, a connector of another preferred form of the present invention might be utilised. Some ventilator apparatus used in hospitals are provided with a dry line (dry breathing conduit) extending from the ventilator or blower that carries dry gas to the humidifier. A further breathing conduit, an inspiratory limb, extends from the humidifier to the patient and carries humidified gases to the patient. A connector that can be used with such a system will now be described.

[0050] The male portion 300 of a dual port cartridge connector is shown in Figures 14 and 15. The dual cartridge connector provides two pneumatic connections, one between the dry line and the humidifier, and the other between the inspiratory limb and the humidifier. This connector also provides for an electrical connection from the humidifier to the wires residing in each of the dry line and inspiratory limb. The male portion 300 has four tubular shaped protrusions that each defines a port 301, 302, 303, 304. The first port 301 is connected to the conduit of the dry line, and the second port 302 is connected to the conduit of the inspiratory limb. The third 303 and fourth 304 tubular shaped ports are connected via a female portion 305 (as shown in Figures 16 and 17) to the humidifier. The male portion also has located on it a rectangular shaped recess 306 that has contacts within it that meet with the electrical wires running within or about the tubes.

[0051] To provide a pneumatic connection between each of the tubes and a humidifier the third 303 and fourth 304 ports are inserted into complementary shaped recesses 307, 308 in the female portion 305 and a latch (not shown) is inserted in a recess that causes

body 622. The other end of the body 622 terminates in an o-ring 624 that causes the sealing between the male portion 602 and the female portion 601 when in use. Where the top of the rim 623 extends out from the side of the body 622 there is an elongate protrusion 625 of the shape and size of the recess 618 formed in the female portion 601 extending out and upward from the surface of the rim 623. Within the protrusion 625 are elongate recesses 626 that receive the pins 621 when the male portion 602 is inserted within the female portion 601.

[0044] Localised pathway along the body 622 of the male portion 602 are two horizontal recesses, of which only one is shown in Figure 33. The recesses 627 are shallow and located on the outer surface of the body 622, but do not extend through to the inner surface of the body 622.

[0045] In use, once the female portion 601 has been moulded to the breathing conduit 619 the sliding collar 600 is slid over the conduit and about the female portion 601. Figure 34 shows the sliding collar only partially covering the female portion 601, whereas in Figures 35 and 36 show the sliding collar 600 covering all of the female portion 601. To lock the sliding collar 600 about the female portion 601 the protrusion (not shown) on the inner surface of the collar 600 is received by the small protrusion 617 on the female portion. To remove the collar from the female portion 601 the user need only grip the collar at the depressions 606 and pull the collar upwards to remove it from the female portion 601. Other means of locking the collar to the female portion are envisaged, such as twisting the collar about the female portion after the collar is slid onto the female portion, or a bayonet type or frictional fitting.

[0046] When the male portion is connected to the chamber of a humidifier by appropriate means, or if it is integrally moulded with the humidifier chamber, wires 627 extend from the male portion 602 to the humidifier heater base or other power source connected to the humidifier. These wires 627 terminate within the protrusion 625 at contacts within the recesses 626 so that when the female portion is coupled with the male portion the pins 621 slide into the elongate recesses 626 and meet with the contacts forming an electrical connection between the humidifier and wires on the breathing conduit.

[0047] In use, a pneumatic connection is caused between the male and female portion when the male portion 602 is inserted within the female portion 601 and the pivoting members slide along the body 622 of the male portion 602 and into the horizontal recesses 627. The inside edges of the pivoting members have lips 628 that extend inwardly. When the sliding collar 600 is passed down over the female portion 601 the pivoting members are pushed inwards and the lips 628 are pushed into the recesses 627 on the body 622 of the male portion 602. If an upward pulling force was placed upon the breathing conduit 619 the locking together of the male and female portions prevents the breathing conduit and female portion from being removed from the

30 is of a generally tubular shape where the collar has two sections an upper section 603 and lower section 604. The lower section 604 is oval in cross-section and upper section 603 that becomes circular in cross-section at its edge 605. Located on the exterior surface of the lower section 604 are depressions 606 that are the shape and size of a human finger pad so that the depressions 606 form a gripping surface for a user's fingers. As shown in Figure 30, on the interior surface of the lower section 604, on the lower edge 607 at least one but preferably two spaced apart small protrusions 608 are integrally moulded in the collar 600. These protrusions 608 slide within complementary slots in the female portion 601 when the collar 600 is slid over the female portion 601.

[0041] Referring now to Figures 31 and 32, which depicts the female portion 601 of the connector of the third form. The female portion 601 has upper and lower sections 609, 610 and is of a corresponding shape, but slightly smaller in diameter, to the sliding collar 600. Therefore, the upper section 609 reduces in diameter from the lower section 610 to an outer and upper edge 611. Integrally formed within the lower section are two pivoting members 612, 613, where the free end 614 forms a flexible member that is movable out of the plane of the sides of the lower section 610. The free ends 614 are moulded so that they protrude out of the surface of the lower section 610. The other pivoting end 615 of the pivoting member 612 is attached to the upper edge 616 of the lower section 610. The pivoting members 612, 613 are flexible and so allow the free ends 614 to be pushed inwards past the external surface of the female portion 601. Located on the surface of the lower section 610 is a dimple for aperture 617 that receives a complementary shaped protrusion located on the inner surface of the sliding collar 600 when the collar 600 is slid over and about the female portion 601. Formed within the lower section 610 is an electrical port or recess 618 that houses pins as shown in Figure 35, which will be described in more detail below.

[0042] The female portion 601 is moulded in a polypropylene or other appropriate plastics material over the tube 619 as shown in Figures 34 to 36. Referring to Figure 35 during or before the moulding of the female portion 601 over the tube 619, the wires (that reside within the breathing conduit 620 encircling the conduit 619), are connected to standard wiring and subsequently to electrical pins 621 residing within the recess 618 formed during the moulding process.

[0043] Referring to Figure 33 that depicts the male portion 602 of the connector of the present invention. The male portion 602 is formed from a plastics type material by injection moulding, but may be formed from other appropriate materials using other appropriate methods. The male portion is generally tubular in shape to allow gases to pass there through. It has a main body 622 that has a rim 623 located near to one end of the

and said coupling simultaneously causing said electrical connector means to engage with said electrical connector receiving means making a pneumatic seal and electrical connection between said male and female portions and consequently between said gases supply means and said conduit.

2. A connector according to claim 1 wherein said gases supply means is a humidifier. 10
3. A connector according to claim 1 wherein said gases supply means is an integrated blower and humidifier. 15
4. A connector according to claim 1 wherein said gases supply means is a positive pressure ventilation device. 15
5. A connector according to any one of claims 1 to 4 wherein said locking connector means is a recess located on the external surface of said male portion. 20
6. A connector according to any one of claims 1 to 5 wherein said locking connector means is a thread disposed upon the external surface of said male portion. 25
7. A connector according to any one of claims 1 to 5 wherein said locking connector means is a bayonet type fitting located on said male portion. 30
8. A connector according to any one of claims 1 to 7 wherein an electrical socket is located on the external surface of said male portion, said electrical socket having at least one first electrical contact surface and being connected to a power supply. 35
9. A connector according to any one of claims 1 to 8 wherein said locking connector receiving means is a protrusion shaped to engage with said recess to cause the locking of said male and female portions together. 40
10. A connector according to any one of claims 1 to 8 wherein said locking connector receiving means is a thread disposed upon the internal surface of said tubular shaped female portion. 45
11. A connector according to any one of claims 1 to 10 wherein said electrical connector receiving means is a recess having at least one second electrical contact surface shaped to receive said electrical socket and said pins, such that electrical contact is made between said first and second electrical contact surfaces. 50

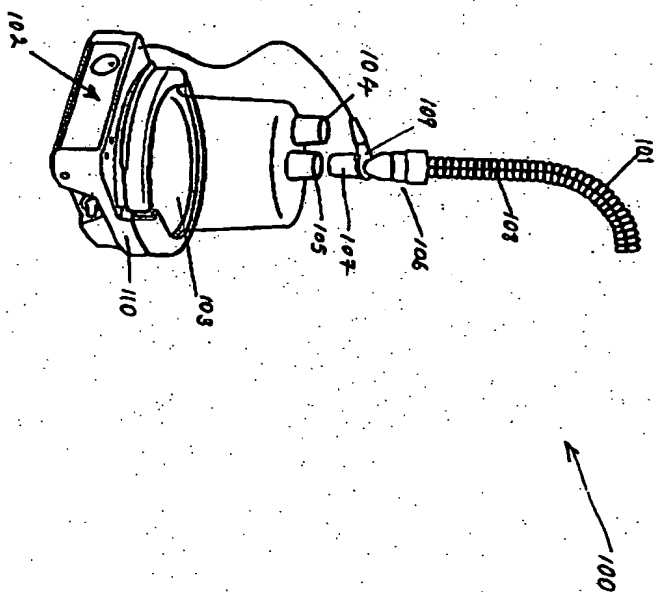


Figure 1

PRIOR ART

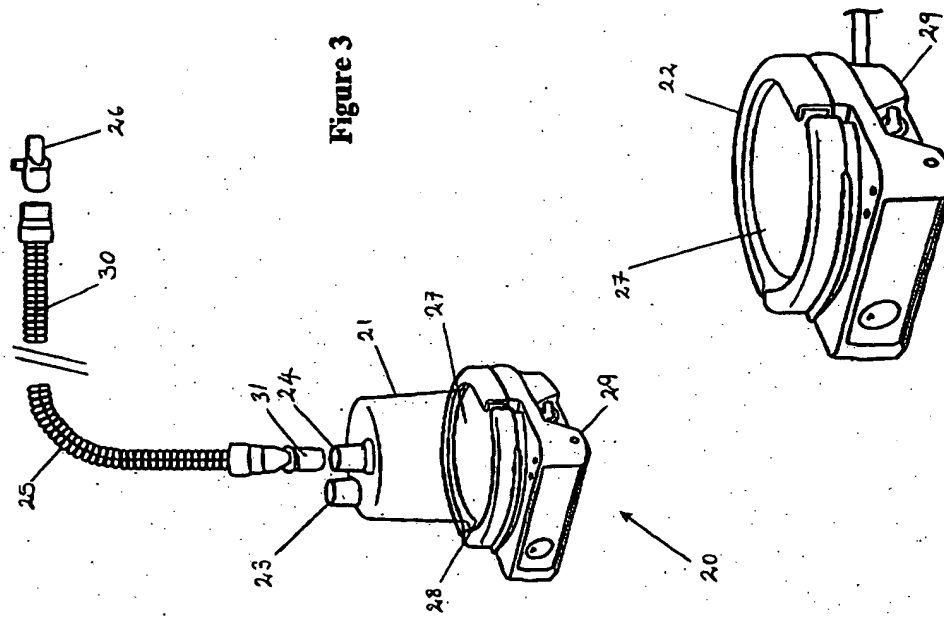


Figure 3

Figure 4

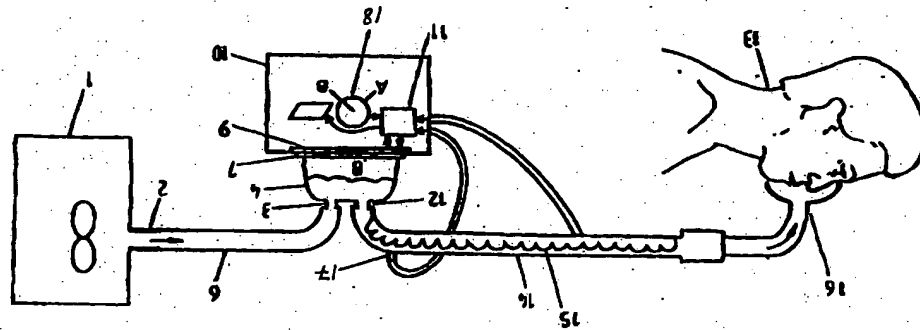


Figure 2

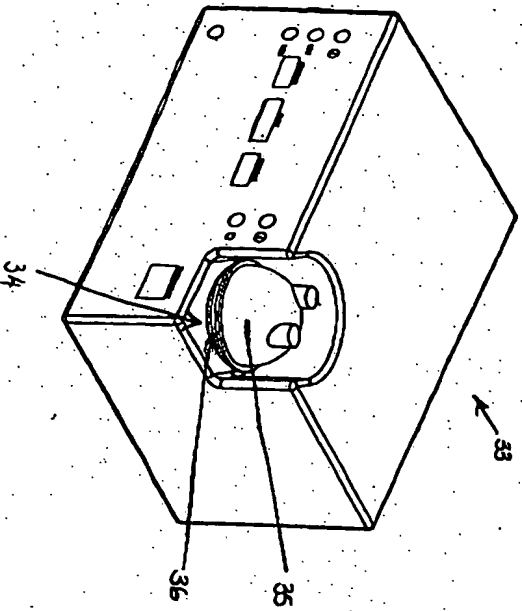


Figure 5

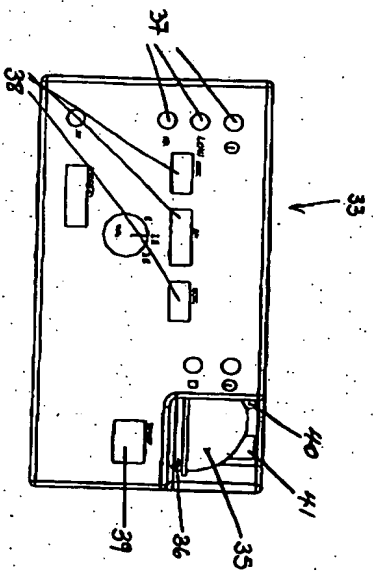


Figure 6

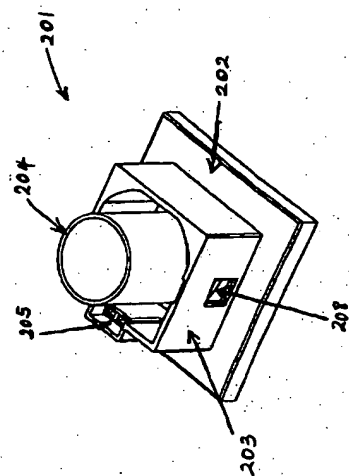


Figure 8

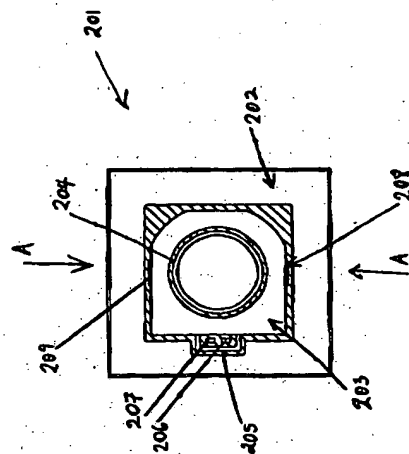


Figure 9

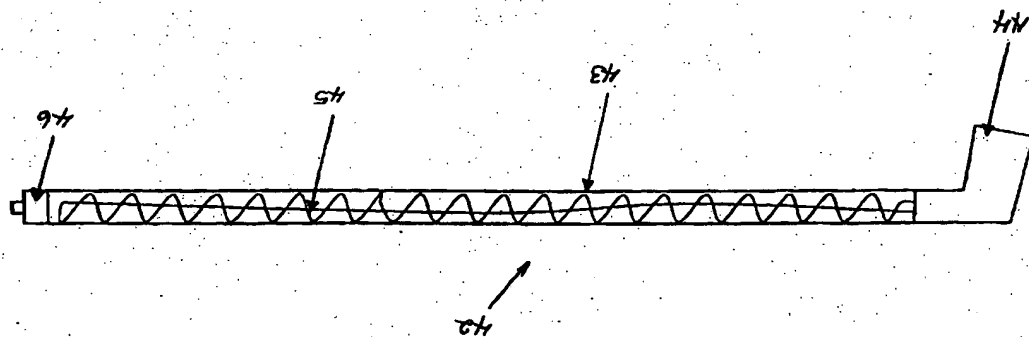


Figure 7

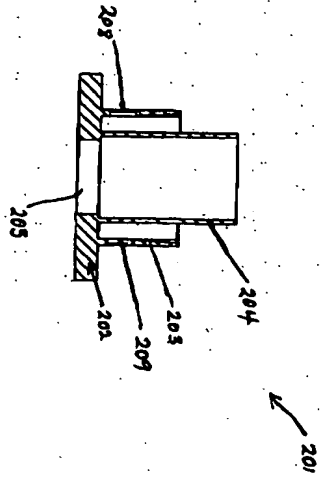


Figure 10

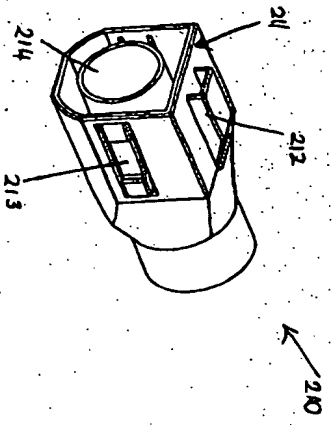


Figure 11

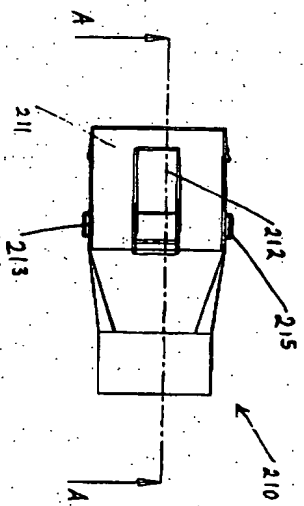


Figure 12

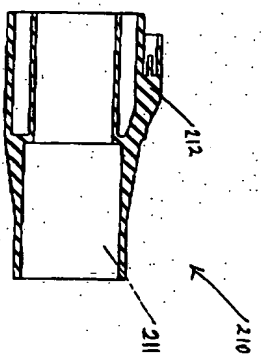


Figure 13

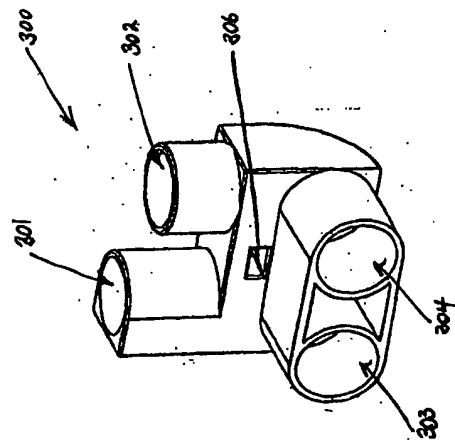


Figure 14

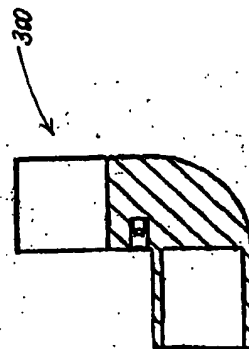


Figure 15

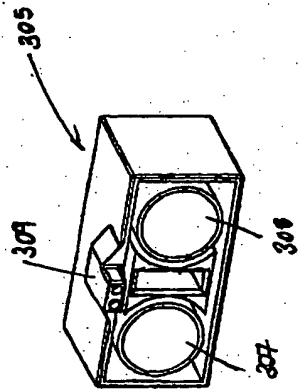


Figure 16

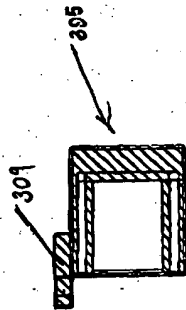


Figure 17

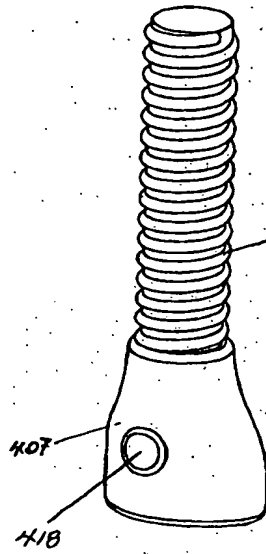


Figure 18

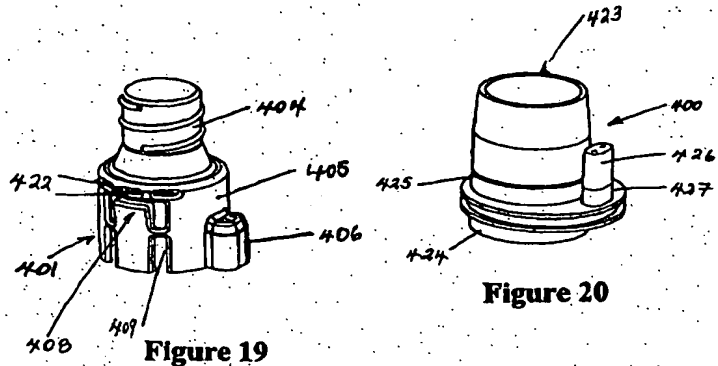


Figure 19

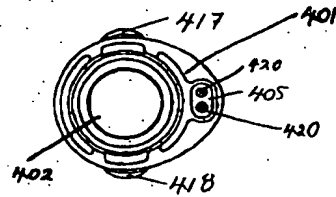


Figure 21

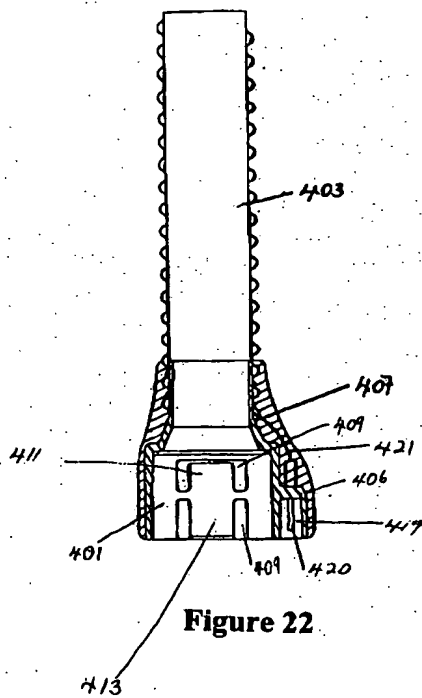


Figure 22

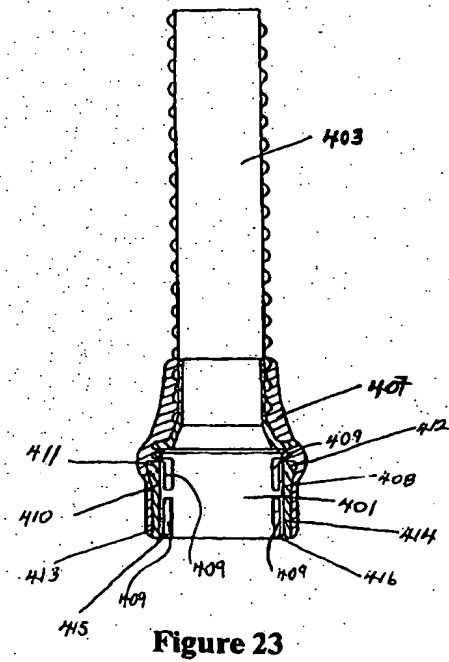


Figure 23

Figure 27

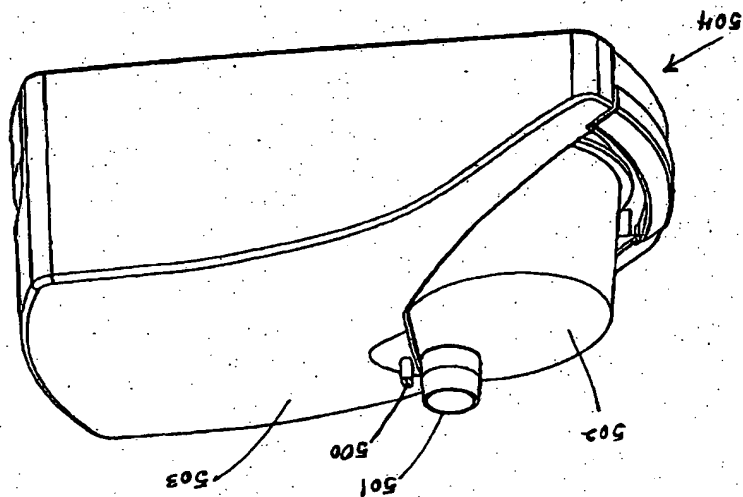


Figure 26

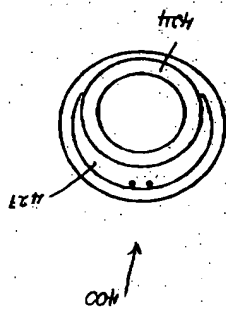


Figure 25

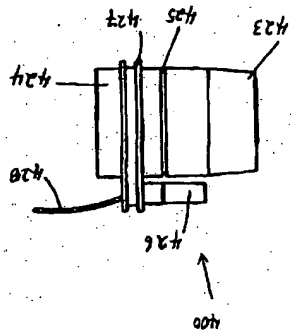
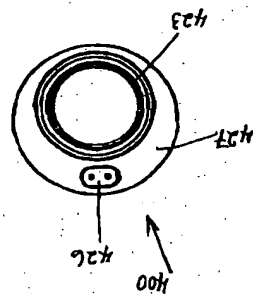


Figure 24



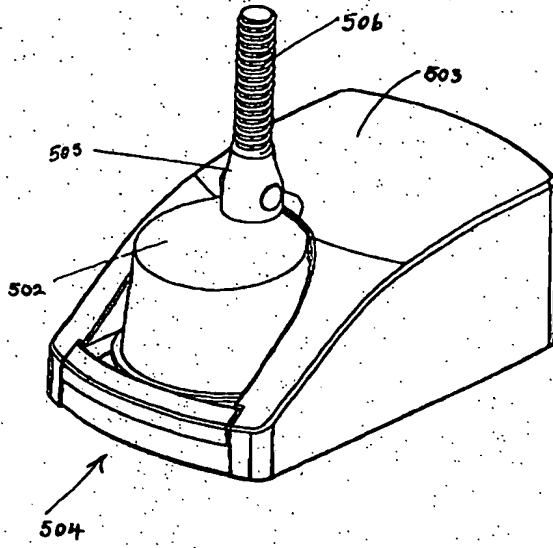


Figure 28

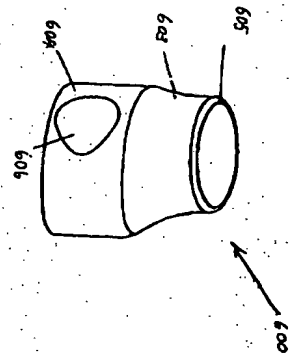


Figure 29

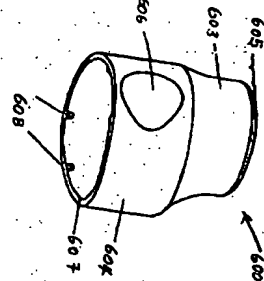


Figure 30

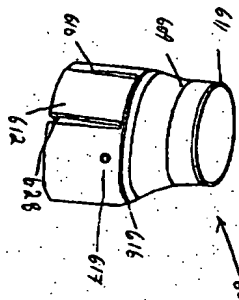


Figure 31

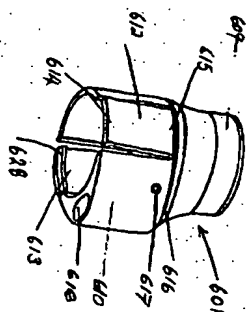


Figure 32

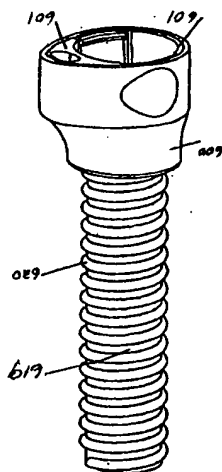


Figure 36

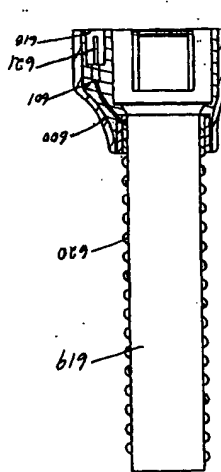


Figure 35

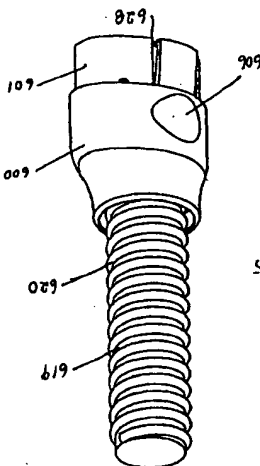


Figure 34

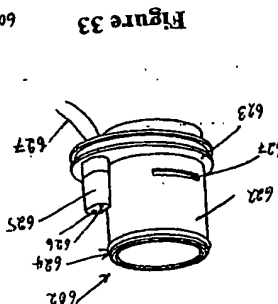


Figure 33

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P, X	US 2803/059213 A1 (MACKIE SCOTT ROBERT ET AL) 27 March 2003 (2003-03-27) * page 4, paragraphs 71-73 * * figures 8A-8E *	ET 1	TECHNICAL FIELD (INCL/7) A61M F16L
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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 17 September 2003	Examiner Azzizola, M
CATEGORY OF CITED DOCUMENTS X: particularly relevant if known alone Y: particularly relevant if combined with another document A: non-patent literature B: technical background C: prior art D: non-written disclosure P: information document		T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date of the application L: document cited for other reasons N: number of the same patent family, corresponding document	

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The annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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